

the greater number of revolutions will the samara perform ere reaching the ground, and the longer consequently will be the path through which its friction is exercised.

In seeking a model for a screw-propeller, we must remember that the pitch should *vary* with the velocity of propulsion.

London, April 15

WM McLAURIN

OUR ASTRONOMICAL COLUMN

THE ROTATION OF VENUS.—It was Jean Dominique Cassini (Cassini I. as he has frequently been designated) who during his residence in Italy, made the first serious attempt to ascertain the time of rotation of this planet and the position of the axis. His observations with one of Campani's long telescopes appear to have been commenced about the middle of the seventeenth century, as related in the *Journal des Savans*, 1667, Dec. 12, but it was not until the evening of Oct. 14, 1666, that he perceived any spot of sufficiently definite aspect to be of service for the purpose in view. It is described as "Une partie claire située proche de la section, et fort éloignée du centre de cette planète vers le septentrion." At the same time several dusky spots were noted. These observations were continued till June 1667, but Cassini expressed himself very cautiously with regard to the inferences to be drawn from them. They appeared to indicate a return of the bright spots to the same position upon the disc at intervals of about twenty-three hours, but from the short time that the spots could be followed Cassini was unable to decide whether the appearances were to be attributed to an axial rotation or to a libration. "De dire maintenant," he says, "supposé que ce soit toujours la même partie luisante, si ce mouvement se fait par une libration, c'est ce que je n'oserais encore assurer, parce que je n'ai pas pu voir la continuité de ce mouvement dans une grande partie de l'arc, comme dans les autres planètes, et par cette même raison cela sera toujours très-difficile à déterminer."

In 1726 Bianchini, domestic prelate of the Pope, observing at Rome, with glasses, also by Campani, of 70 to 100 Roman palms in focus, remarked on Feb. 9 several spots which he continued to observe with the view to determine the time of rotation. His observations were published in "Hesperii et Phosphori nova Phenomena," 1728, and he considered them to show a period of rotation of 24 days 8 hours, the North pole of Venus being directed to longitude 320° , with an inclination of 15° only to the plane of the ecliptic. Bianchini's observations appear to have been made under very unfavourable conditions, whereby he was prevented from following the spots in a continuous manner. They were discussed at length by Jacques Cassini, the son of Jean Dominique, in "Elemens d'Astronomie" (1740), who arrived at the conclusion that a rotation of 23 hours 20 minutes would represent equally well his father's observations and those of Bianchini, while if the rotation assigned by the latter was admitted, it would be necessary to reject entirely the observations of the elder Cassini, "comme n'étant qu'une apparence trompeuse."

Jacques Cassini mentions that after Bianchini had communicated to him the observations at Rome, he made attempts to discern the spots upon Venus at Paris. He examined the planet on a great number of occasions with a glass of 114 feet focus, one of the best produced by Hartsoëker, and also with one of Campani's, of 120 Roman palms' focus, which had been tried by Bianchini and considered excellent, but with all the precautions taken neither he nor Maraldi could perceive any distinct spot upon the planet's disc.

Schroeter, in 1789, examining Venus with a 7-feet reflector, discerned a bright spot in the dark hemisphere, and by following the appearance of this object, inferred that the planet rotated in 23h. 21m. 19s., thus supporting the result obtained by Jacques Cassini from his father's

observations. Schroeter's observations appear in D. J. H. Schroeter, "Cythereographische Fragmente, oder Beobachtungen über sehr Betrachtlichen geberge und rotation der Venus," Erfurt, 1792; and in "Aphroditographische Fragmente, &c.," Helmstadt, 1796. In an appendix to the latter work, noticed by Zach in "Monatliche Correspondenz," xxv. p. 366, it is stated that observations of "atmospheric spots," and of the horns, with eight determinations of "a definite point upon the surface," give for the final value of the rotation-period of Venus, 23h. 21m. 7⁹/₈s.

De Vico's observations and investigations bearing upon the time of rotation and the position of the axis are published in "Memoria della Specola . . . in Collegio Romano," 1840-41, p. 32, and in the succeeding part of the same for 1842, p. 29. The period of rotation assigned from these observations, which were made with the Cauchoix refractor of the Roman College, is 23h. 21m. 21⁹/₃₅s. (sidereal time). The longitude of the ascending node of the equator of Venus upon her orbit is fixed to $56^\circ 30'$, and the inclination thereto $53^\circ 11'$, while for the same elements referred to the ecliptic we have $57^\circ 19'$ and $49^\circ 57'$. There is some error of the press or of calculation here which it is not easy to rectify. In a note to Secchi's Life of De Vico, "Memorie dell'Osservatorio . . . in Collegio Romano," Anno 1850, p. 140, the inclination of the equator of Venus to the ecliptic is given, $53^\circ 11' 26''$, and the longitude of the ascending node of the equator upon the ecliptic for 1841, $57^\circ 19' 18''$.

Notwithstanding the near agreement of De Vico's period of rotation with that assigned by Schroeter, it must be admitted that further investigation is very essential before we can consider the period established. There are so many negative observations upon record and these made under circumstances at least as favourable as those upon which the rotation of the planet has been supposed to be fixed, that there is ample justification for doubt in the matter.

We hear from more than one correspondent that dusky spots have been suspected upon the disc of Venus, within the last few weeks; if there be no illusion, the present may prove a favourable opportunity for attempting a new determination of the rotation-period, and this consideration has suggested the above outline of the actual state of our knowledge upon the subject.

MINOR PLANETS.—By a note from Herr Palisa it would appear that the small planet observed at Pola on November 22 and 23 was not, as supposed at the time, identical with the one he had detected on November 8. No. 155 is therefore lost or in similar predicament to the planet observed by Watson, 1873, July 29.

M. Leverrier's *Bulletin International*, of April 22, announces the discovery of another small planet at Paris, by M. Prosper Henry, during the previous night, in R.A. 14h. 9m. 58s., N.P.D., $102^\circ 18'$.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXIST- ING MAMMALIA¹

VIII.

THE existing families of the Carnivora, spoken of in the last lecture, do not appear to have been distinctly differentiated in the Eocene period, at all events not till towards its close, but the order was represented by other and very singular forms, the systematic position of which is not easy to determine. The earliest in point of time is *Arctocyon primævus*, from the lowest Eocene of La Fère, Aisne, France, an animal nearly as large as a wolf, with a long tail, and heavy, strong limb bones, and

¹ Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 488.

remarkable for the exceedingly small size of the brain cavity, compared with the arches and ridges of the skull developed for muscular attachments. This character has been supposed to indicate marsupial affinities, but the rest of the osteology, as far as known, does not favour this view. The lower jaw has not been found, but the cranium shows the full complement of teeth so frequent in Eocene mammals. There are three broad tubercular molars behind the trihedral sectorial, which indicate that the animal was rather omnivorous than truly carnivorous in its habits. Another genus which includes many species of various size, and having a wide geographical range, being found in late Eocene and early Miocene deposits in France, Germany, England, and North America, is called *Hyænodon*. It also has been by many naturalists placed among the marsupials on account of the peculiarities of its dentition, which is certainly without parallel among placental Carnivores. It possesses the primitive or typical dental formula of the Eocene mammals, and the incisors, canines, and premolars, are not unlike those of a dog, but the three true molars, both above and below, are shaped like the sectorial teeth of a cat or hyæna, and increase in size from the first to the last, and thus there are no teeth formed like the "tuberculars" of ordinary Carnivores. This repetition of the sectorial character in the true molar occurs in the carnivorous marsupials, though the general structure of the skull, and limb bones as far as they are known, including the position of the lachrymal canal within the orbit, will not permit our placing *Hyænodon* in that group. Many of the lately discovered American Eocene carnivores presented the same peculiarity of several successive molars having sectorial characters. One of these from Wyoming, apparently allied to *Hyænodon*, has been described by Cope, under the name of *Mesonyx*, and another still more aberrant form, as *Synoplotherium*. The inferior canines project forwards, and are closely approximated, the incisors (at all events in the aged specimen on which the genus was founded) being absent. The molar teeth were so much worn that their characters cannot be satisfactorily made out. The most interesting features of these animals are in the structure of the feet, the ungual phalanges being flatter and broader than in any existing Carnivora, and grooved above, and the scaphoid and lunar bones of the carpus not being united as in all existing Carnivores.

These naturally lead to the consideration of some animals, the remains of which have been discovered in the same locality and formation, of such anomalous construction, that they cannot be placed in any of the known groups, and for which Prof. Marsh has constituted the order *Tillodontia*. The type of the order *Tillotherium*, Marsh, is described as having a skull with the same general shape as in the bears, but in its structure resembling that of Ungulates. The molar teeth are of the Ungulate type, the canines are small, and in each jaw there is a pair of large scalpriform incisors faced with enamel, and growing from persistent pulps, as in Rodents.

The adult dentition is $i \frac{2}{2} c \frac{1}{1} p \frac{3}{2} m \frac{3}{3}$. The articulation

of the lower jaw with the skull corresponds to that in Ungulates. The brain was small and somewhat convoluted. The skeleton most resembles that of Carnivores, especially the *Ursidae*, but the scaphoid and lunar bones are not united, and there is a third trochanter on the femur. The radius and ulna, and the tibia and fibula, are distinct. The feet are plantigrade, and each had five digits, all terminated by long, compressed and pointed ungual phalanges, somewhat similar to those in the bears. Judging from the figures and description, this animal is the same as that of which a lower jaw was previously described by Leidy as *Trogosus castoridens*, and which is perhaps identical with *Anchippodus riparius*, described by the same naturalist at a still earlier date, from a single tooth from New Jersey. If this identity can be satisfac-

torily established, the latter name must be adopted, but as the lower molars of so many very different animals bear a close resemblance to each other, it is not very easy to do so, and the whole history is a good illustration of the inconvenience that often arises from the practice of giving names to minute and isolated fragments.

In some of its dental and osteological characters, *Tillotherium* or *Anchippodus* bears some resemblance to the *Rodentia*, but the definition of that order would have to be widened considerably before it could be admitted within its bounds. *Mesotherium*, spoken of in the third lecture, has better claims to be considered a Rodent, though certainly a very aberrant one. Leaving this animal aside, palæontology tells us nothing of connecting, or even of more greatly generalised forms of Rodents, or affords any better indications of the affinities of the order than can be derived from the study of its living members. Nearly all the existing families have been well represented throughout the Pliocene and Miocene epochs, and the earliest known Rodents, those of the Upper Eocene, do not appear to have been more generalised than the existing species.

Numerous species of extinct *Insectivora* have been described from various formations from the Upper Eocene to the present time, both in Europe and America, but their characters and affinities have not been thoroughly worked. The European species mostly belong or are allied to genera now existing. It has been suggested that some of the generalised American Eocene Carnivores may possibly be gigantic *Insectivora*, though in the actual fauna of the world there are no connecting links between these orders. It is also not certain whether some of the mammals of the Mesozoic strata may not be placental *Insectivores*.

The *Chiroptera*, or bats, differ strikingly from all other mammals in the adaptation of the fore-limbs as organs of true flight. Their origin is an extremely interesting question to the evolutionist. No existing forms throw any light upon it, and what little is known of the past history of the order shows that its general characters and geographical distribution have not changed materially during the Tertiary period. All the bats found fossil in the Brazilian caves resemble those now inhabiting the same country, though it is true these only go back as far as Pleistocene ages. In France, however, remains of bats have been found in the Miocene and Upper Eocene (Paris gypsum), but all belonging to the *Vespertilioninae* and *Rhinolophidae*, families now existing in Europe, and in the earliest known forms no signs of generalisation have been detected, nor have any of the intermediate stages between the ordinary mammal and the bat, if they ever existed, yet been discovered. No fossil remains of the large fruit-eating bats, or *Pteropi* have been found.

(To be continued.)

PROF. HUXLEY'S LECTURES ON THE EVIDENCE AS TO THE ORIGIN OF EXISTING VERTEBRATE ANIMALS¹

V.

WE saw in the last lecture that the differences between birds and reptiles were very great; nevertheless, many of them tend to disappear on a closer examination. For instance, the extremely avian character of the absence of teeth, and the presence of a horny beak, is found in turtles and tortoises; that of the penetration of the bones by air cavities exists in the skull of crocodiles; and, although no existing reptile possesses the power of flight, or a fore-limb in any way approaching in structure to a bird's wing, yet, in the crocodiles, the fourth and fifth digits—those we found to be wholly absent in the bird—are much smaller than the others, and have no claws.

¹ A course of six lectures to working men, delivered in the theatre of the Royal School of Mines. Lecture V., March 27. Continued from p. 469.